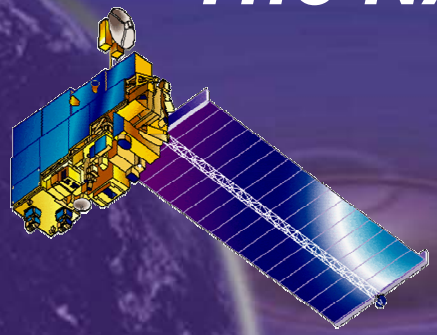
Earth Science Applications

The NASA Vision



To improve life here

To extend life to there

To find life beyond.

The NASA Mission

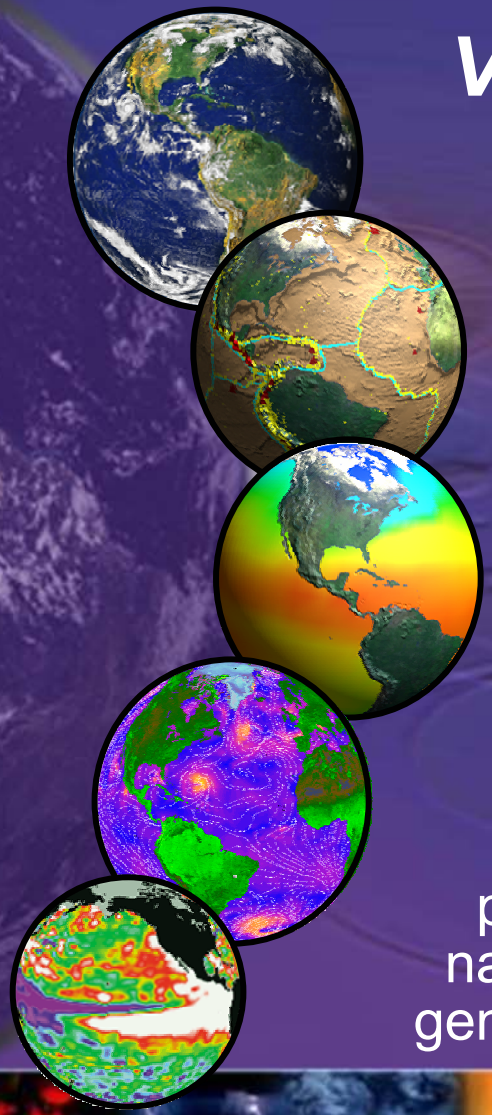
To understand and protect our home planet

To explore the universe and search for life

To inspire the next generation of explorers

…as only NASA can.

Earth Science Enterprise



Vision

Enable effective applications of Earth science information that benefit the quality of life on Earth.

Mission

Develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations.

NASA's Earth Science Enterprise Applications Program

Mission

Expand and accelerate the realization of societal and economic benefits from Earth science, information, and technology.

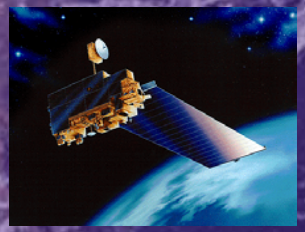
Science Questions

Variability	Forcing	Response	Consequence	Prediction
Precipitation, evaporation & cycling of water changing?	Atmospheric constituents & solar radiation on climate?	Clouds & surface hydrological processes on climate?	Weather variation related to climate variation?	Weather forecasting improvement?
Global ocean circulation varying?	Changes in land cover & land use?	Ecosystem responses & affects on global carbon cycle?	Consequences in land cover & land use?	Transient climate variations?
Global ecosystems changing?	Surface transformation?	Changes in global ocean circulation?	Coastal region change?	Trends in long-term climate?
Stratospheric ozone changing?		Stratospheric trace constituent responses?		Future atmospheric chemical impacts?
Ice cover mass changing?		Sea level affected by climate change?		Future concentrations of carbon dioxide and methane?
Motions of Earth & interior processes?		Pollution effects?		

Critical to Water Cycle
Related to Water Cycle
Other Elements of our Program

Missions Defined by Questions

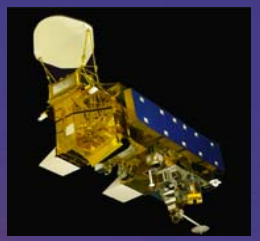
Longer-term Missions - Observation of Key Earth System Interactions



Terra

Landsat 7

QuikScat



Aqua

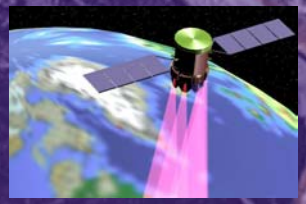
Aura

ICEsat

Jason-1

Exploratory - Explore Specific Earth System Processes and Parameters and Demonstrate Technologies

Triana

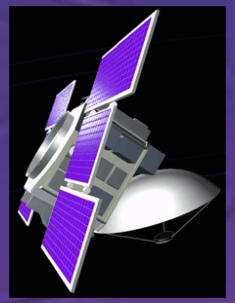


VCL

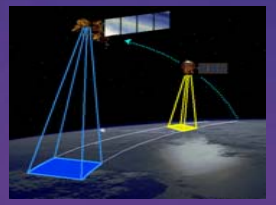
SRTM

GRACE

CALIPSO



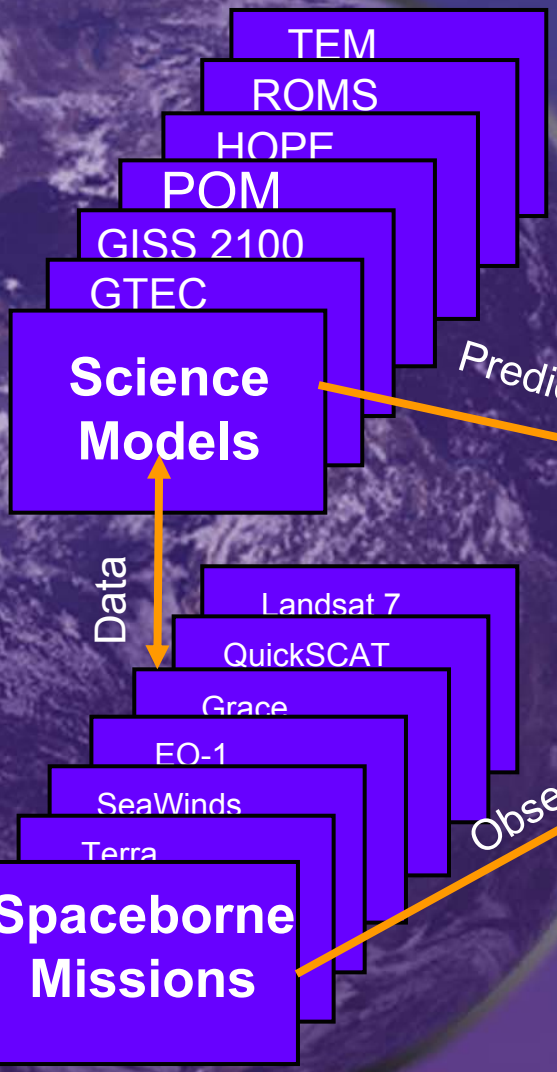
Cloudsat



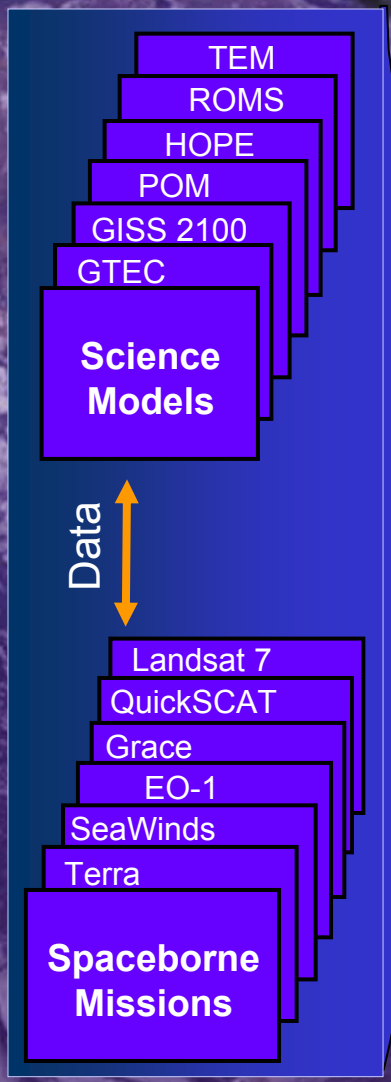
EO-1

Serving Our Nation & World

Providing decision makers with interactive access to dynamic knowledge of our changing Earth



Earth Science Applications Decision Model



Earth Science Applications

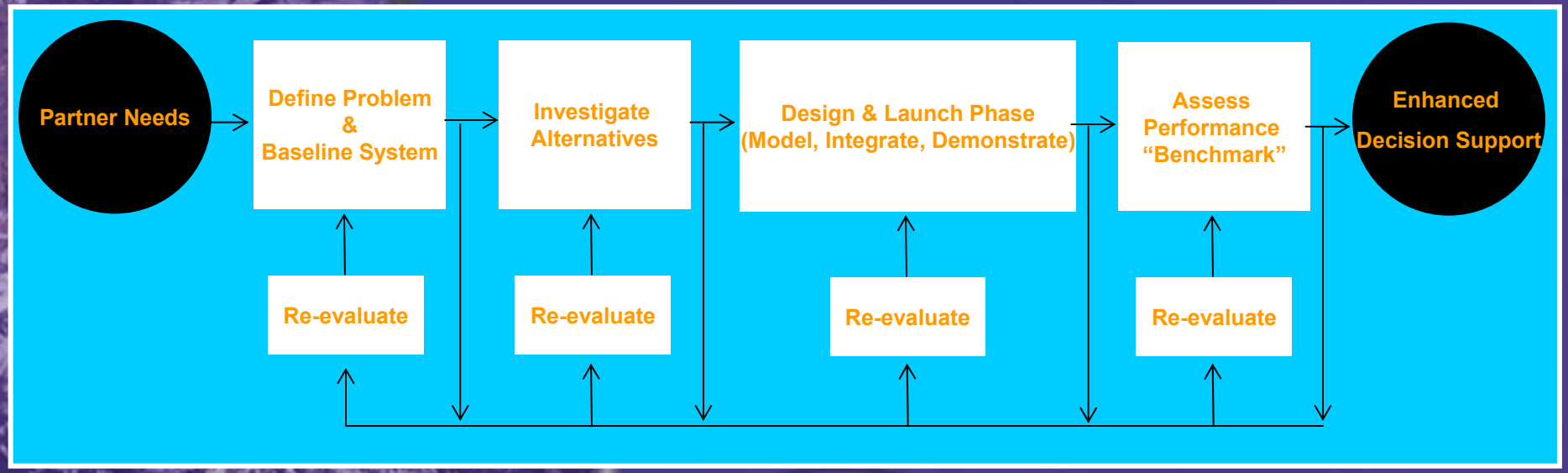
Applications Research → Validation & Verification → Applications Benchmarking

Decision Support Systems

Value & Benefits to citizens & society

- Agricultural Competitiveness
- Air Quality Management
- Aviation Safety
- Carbon Management
- Coastal Management
- Disaster Preparedness
- Community Growth
- Energy Forecasting
- Homeland Security
- National Invasive Species
- Public Health
- Water Management and Conservation

Applications Approach



Adapted from Bahill & Gissing (1998)

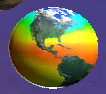
Systems Engineering Approach

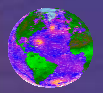
A systems engineering approach leads to scalable, systemic, and sustainable solutions and processes that contribute to the success of the mission, goals and objectives of each National Application.

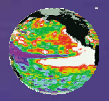
12 National Applications

Agricultural Competitiveness

Air Quality Management

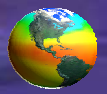

Aviation Safety

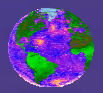

Carbon Management

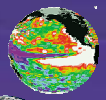

Coastal Management

Disaster Preparedness

Community Growth


Energy Forecasting


Homeland Security


National Invasive Species

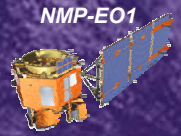
Public Health

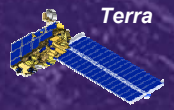
Water Management & Conservation

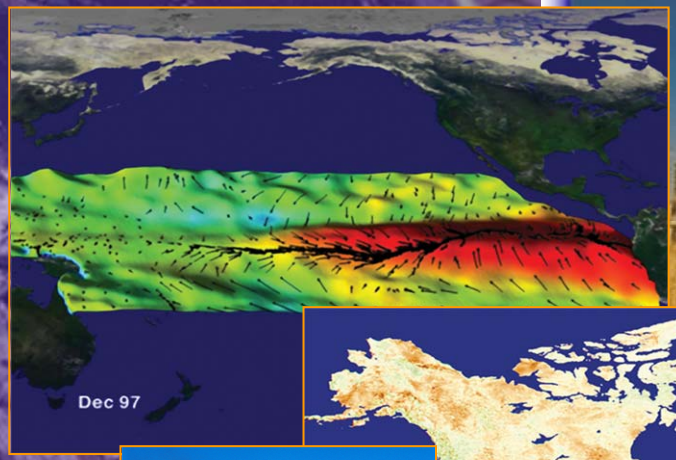
Agricultural Competitiveness

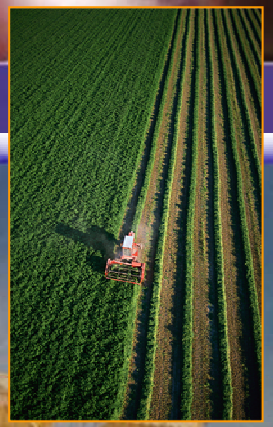
Global Measurements and Models for Agricultural Competitiveness

Global Measurements Applied to Precision Agriculture







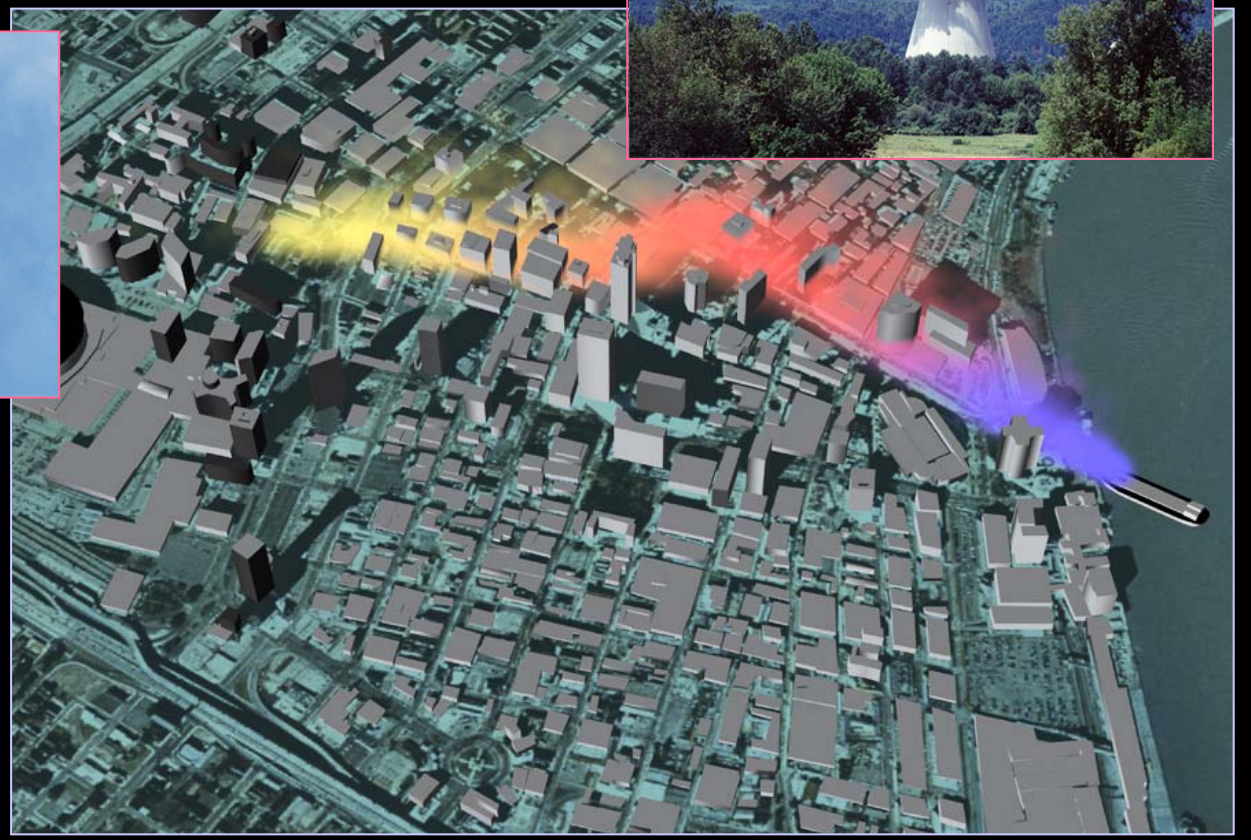


Rienecker, Michele M.; Adamec, David, 2002. Satellite Observations and Seasonal Climate Forecasts for Agricultural Applications, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 12-14.

Air Quality Management

Global Measurements and Models for Air Quality Management

Risk Management Planning for Air Quality



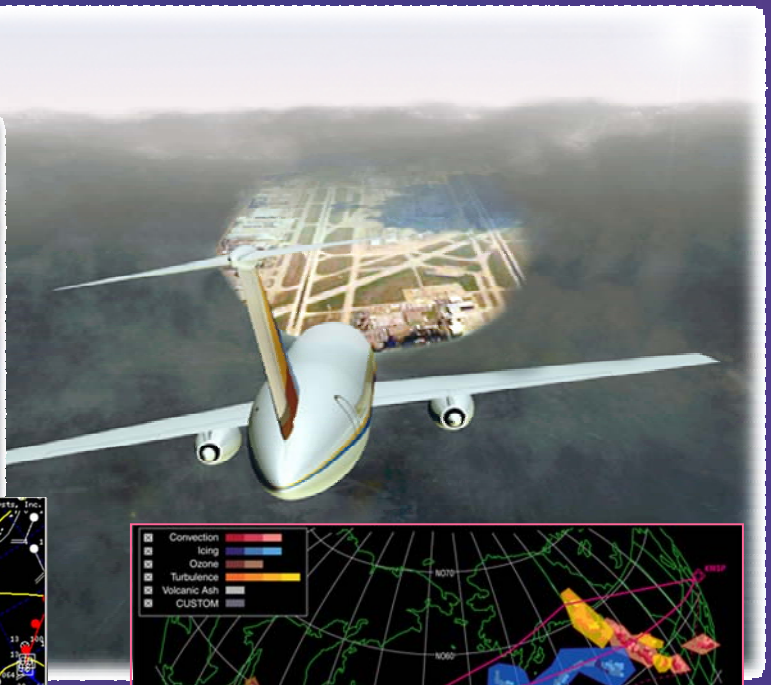
Risk Management Planning, LLC (RMP) specializes in data synthesis and graphic representation of toxic and hazardous chemical releases into the atmosphere.

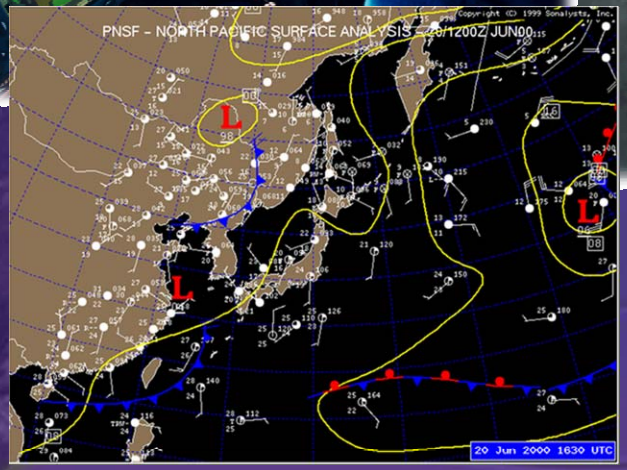
Click black area for visualization

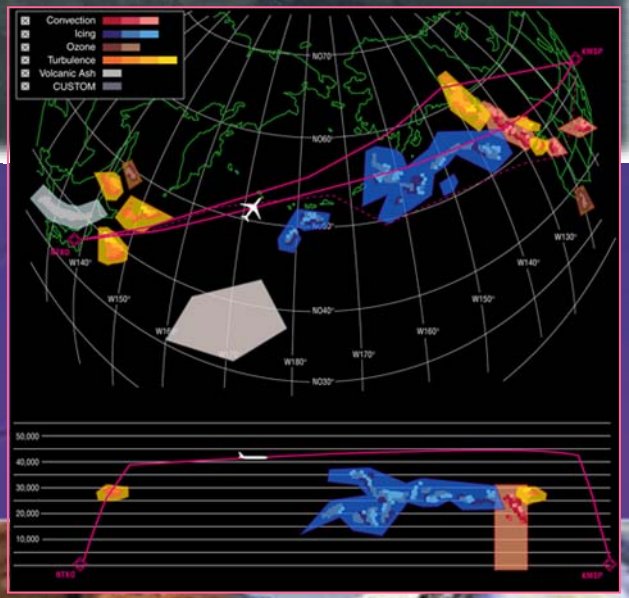
Aviation Safety

Weather, Climate and Natural Hazards Predictions for Aviation Safety

Understanding Aviation Weather Requirements





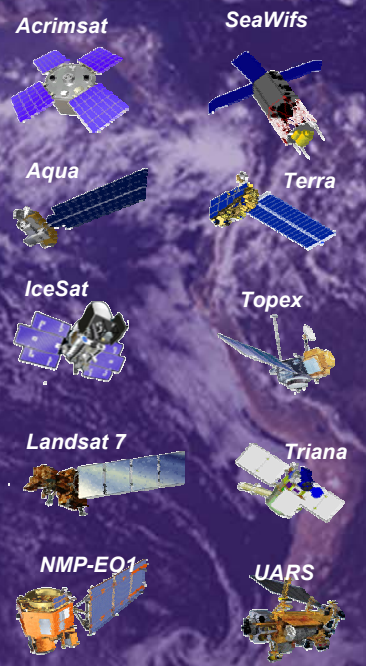


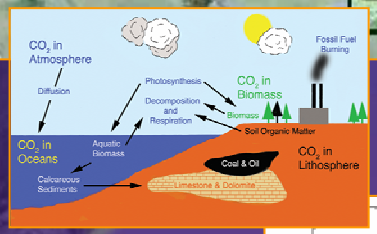
Murray, John J., 2002. Aviation Weather Applications of Earth Science Enterprise Data, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 26-30.

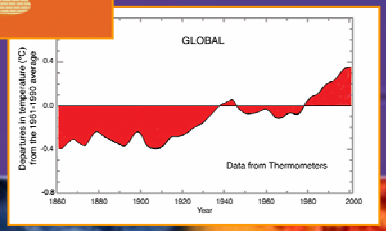
Carbon Management

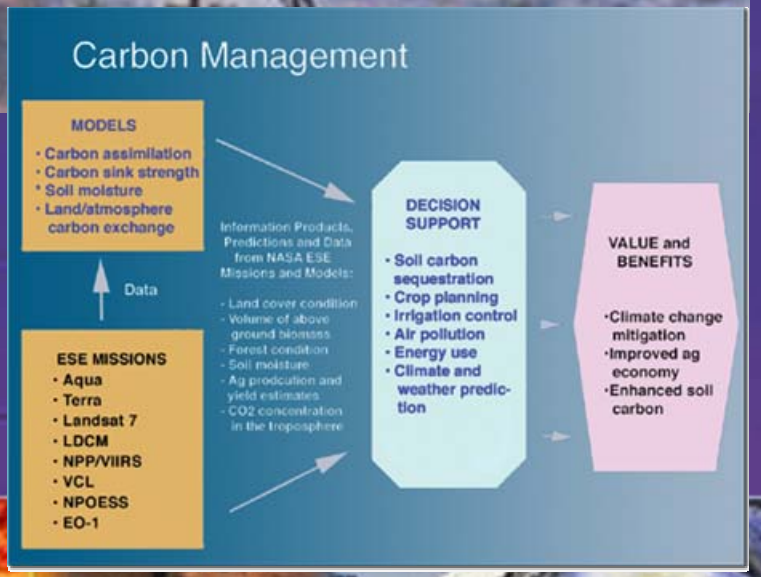
Global Monitoring and Assessments for Carbon Management

Integrating Satellite Remote Sensing into Forest Inventory and Management







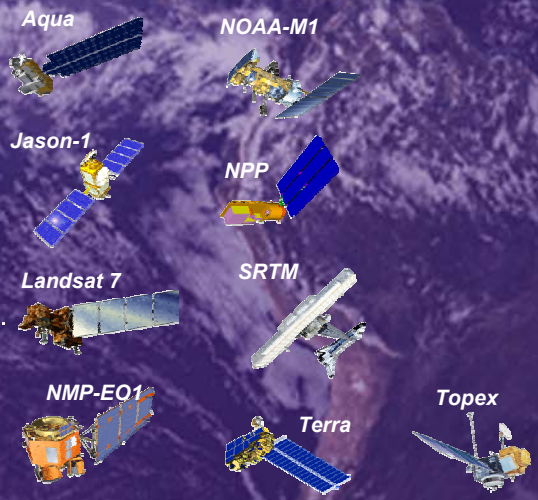


Sheffner, Ed; Fladeland, Matt, 2002. Toward a Carbon Management Regime, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 22-24.

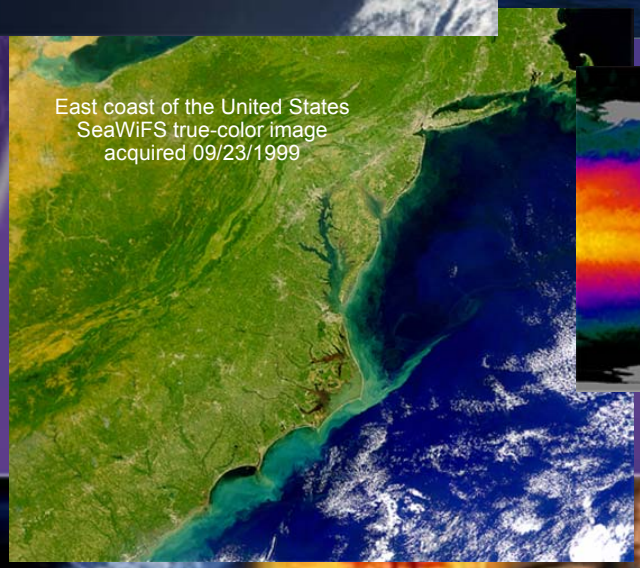
Coastal Management

Global Measurements and Predictions for Coastal Management

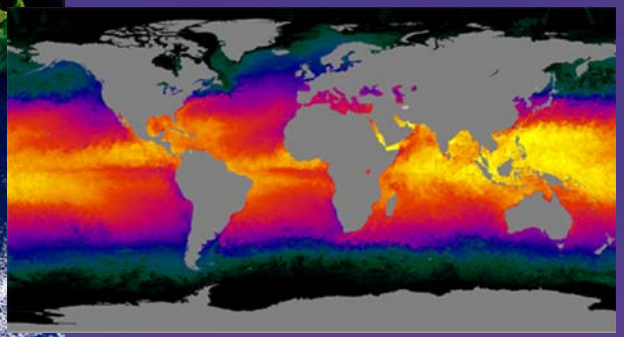
Understanding Coastal Resources Using Global Measurements



Western Gulf of Mexico
MODIS true-color image
acquired 01/15/2002



East coast of the United States
SeaWiFS true-color image
acquired 09/23/1999



Sea surface temperatures measured
by the MODIS sensor on June 2-9, 2001

Herring, David; Weier, John; Gubbels, Timothy, 2002. Environmental Indicators for Coastal Management, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 50-53.

Earth Science Enterprise

Disaster Preparedness

Global Measurements and Predictions for Disaster Management

NASA Contributes Knowledge and Expertise to Emergency Response Efforts

Champ

Jason-1

CloudSat

NOAA-M1

Goes-L

QuikScat

Goes-M

SRTM

Topex

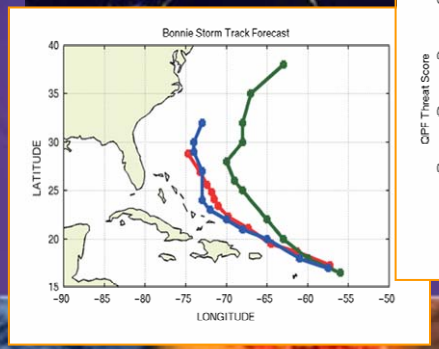
Grace

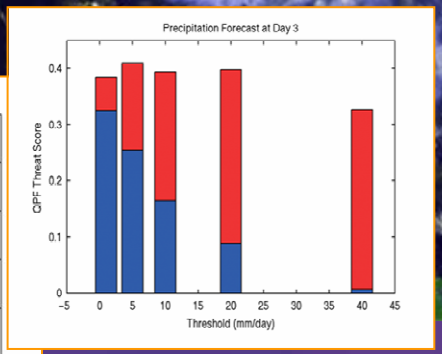
IceSat

TRMM

Click this image for visualization

Provided technical support to FEMA on issues raised by response units such as Urban Search and Rescue and FDNY.





Atlas, Robert; Hou, Arthur; Reale, Oreste, 2002. Hurricane and Flood Prediction for Community Disaster Preparedness, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 38-40.

Community Growth

Weather, Climate and Natural Hazards Earth Science for Community Growth

Community Growth for Infrastructure Development

Acrimsat

SRTM

ERBS

UARS

Sage

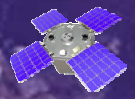
Click black area for visualization

Energy Forecasting

Weather, Climate and Natural Hazards Predictions for Energy Forecasting

Predict Risk and Vulnerability to Natural and Human Influences

Acrimsat



Landsat 7

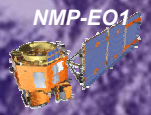
Sage

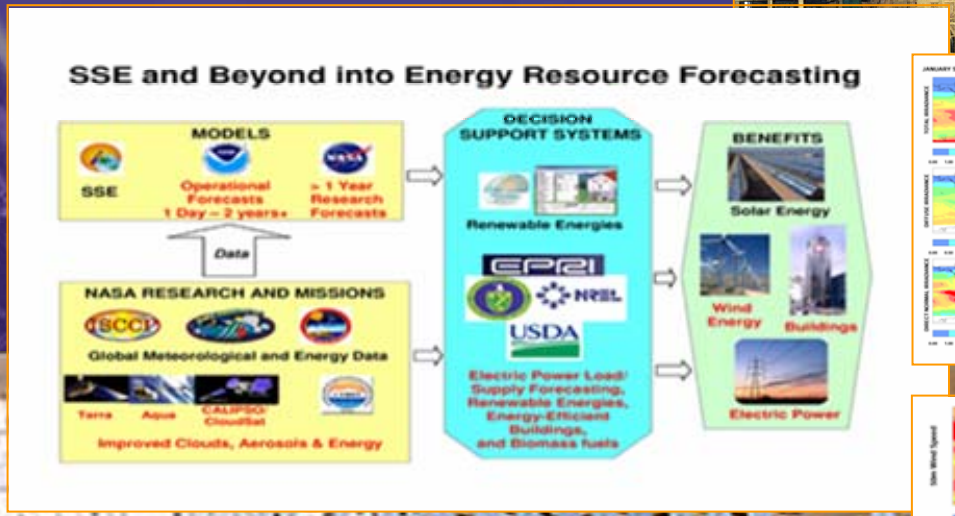
NOAA-M1

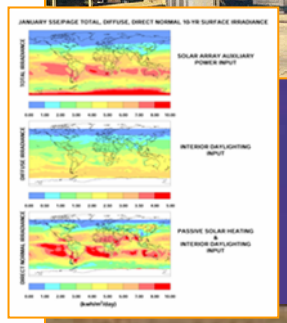
TRMM

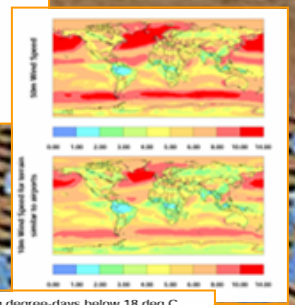
ERBS

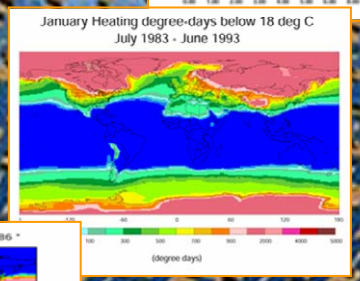
NMP-EO1

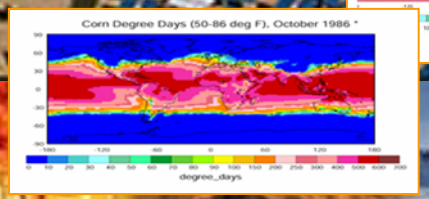










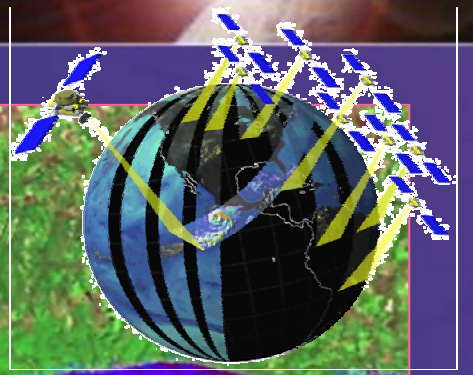


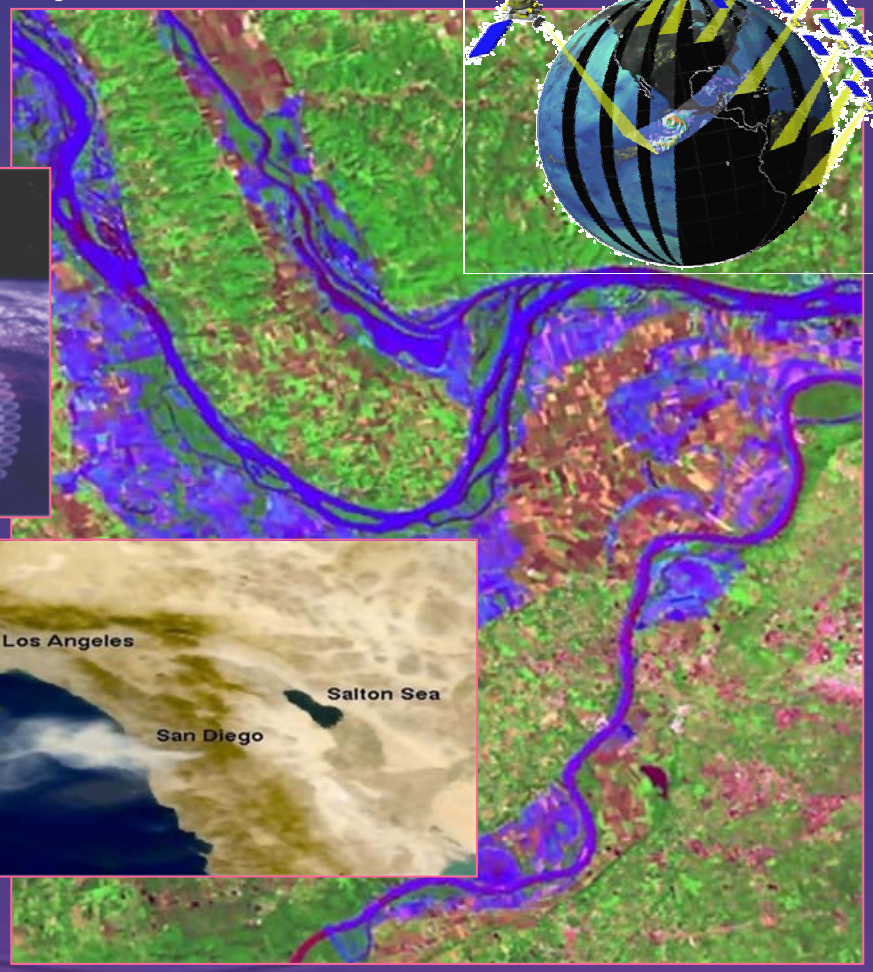
Stackhouse, Dr. Paul W., Jr.; Whitlock, Dr. Charles H.; DiPasquale, Roberta C.; Brown, Donald E., II; Chandler, William S., 2002. Meeting Energy-Sector Needs with NASA Climate Datasets, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 6-10.

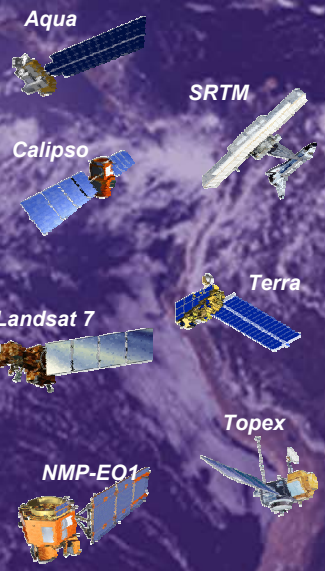
Homeland Security

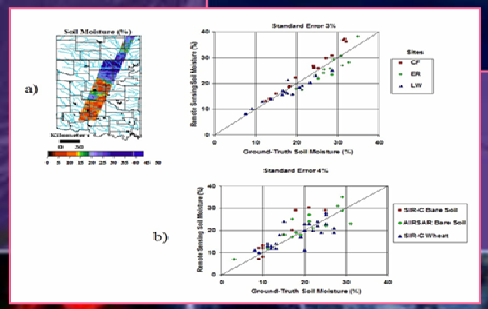
Global Monitoring and Predictions for Homeland Security

Proposed Hydrospheric State Mission to Observe Soil Moisture and Soil Freezing









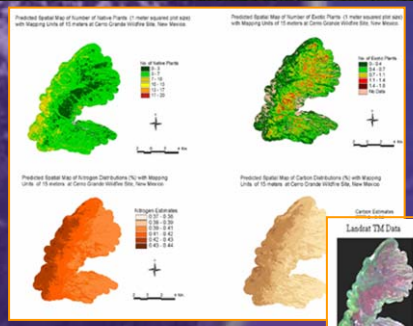
Houser, Paul R., 2002. Air and Water Monitoring for Homeland Security, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 33-36.

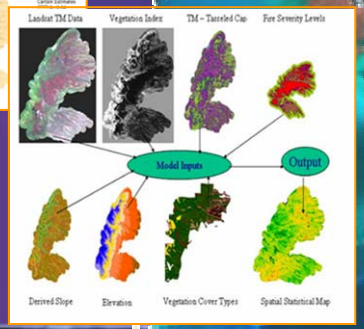
Images of fires near San Diego, CA., acquired January 3, 2001 by ORBIMAGE's Sea-viewing Wide Field-of-view Sensor (SeaWiFS).

National Invasive Species

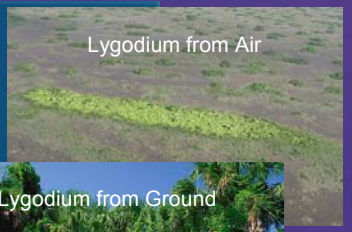
Global Monitoring and Predictions for Invasive Species Such As Diseases, Plant and Animal, etc.

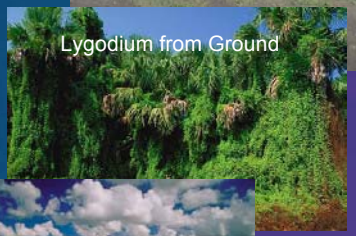
Global Monitoring and Management for Biological Invasions

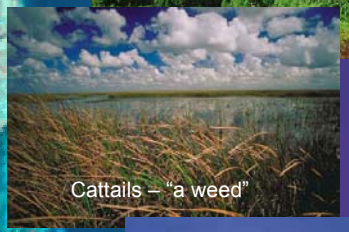


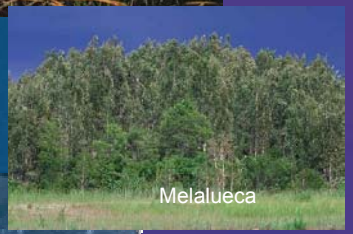


Predicted spatial maps for the native and exotic plant species and for nitrogen and carbon distribution in the Cerro Grande wildfire site near Los Alamos, NM.


Lygodium from Air


Lygodium from Ground


Cattails – "a weed"


Melalueca

Schnase, John L.; Stohlgren, Thomas J.; Smith, James A., 2002. The National Invasive Species Forecasting System: A Strategic NASA/USGS Partnership to Manage Biological Invasions, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 46-49.

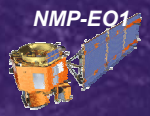
Aqua

Calipso

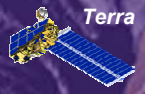
IceSat

Landsat 7

NMP-EO1



Terra



NOAA-M1

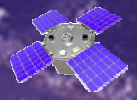
TRMM

Public Health

Global Monitoring and Predictions for Public Health Related to the Environment

Global Monitoring and Predictions for Public Health

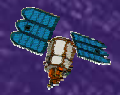
Acrimsat



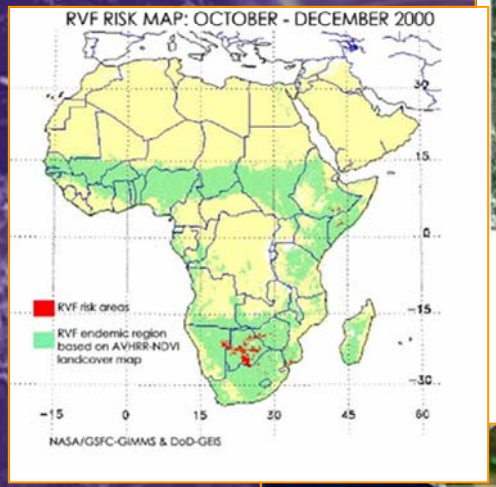
Sage

SRTM

Toms-EP



TRMM



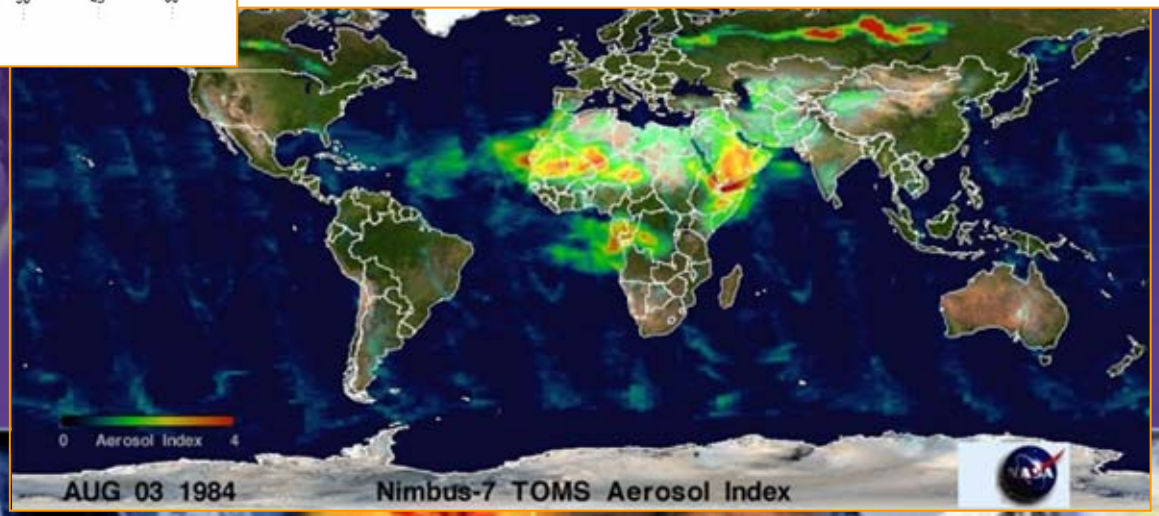
Landsat TM, 11 May 1997

Classification of Landsat TM, 11 May 1997

The land-cover classification for Baltimore City, Md., and vicinity shown at right was derived from the May 1997 Landsat TM image shown at left. These data will be included as part of the spatial database for understanding the relationship between childhood asthma and environmental properties. Image and classification courtesy of Dr. Asad Ullah, Science Systems & Applications Inc.

Classification Legend

- Open Surficial Water
- Urban/Developed Land
- Open/Undeveloped Land
- Roads/Transportation
- Vegetation/Forested Areas

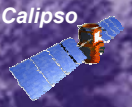


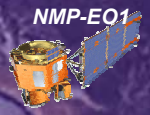
Maynard, Nancy G., 2002. Remote Sensing for Public Health Surveillance and Response, *Earth Observation Magazine*, Vol. 11, No. 8, pp. 43-45.

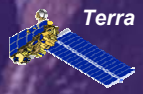
Water Management & Conservation

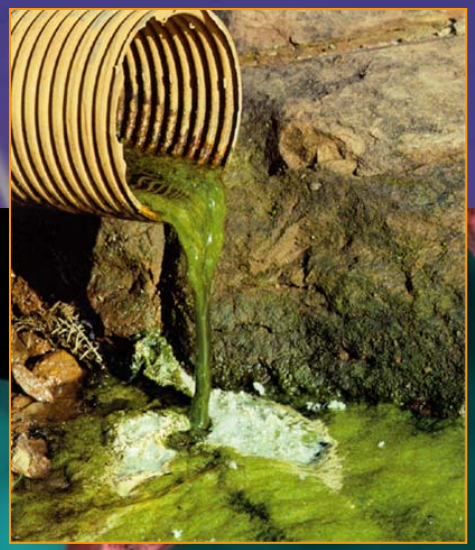
Global Monitoring of Water Quality, Availability and Conservation

Monitoring Effluents at the Bonnet Carré Spillway









ATLAS color infrared image of Lake Pontchartrain, LA